

- 1 -

**NEUTRAL ELECTRODE FOR HF SURGERY**

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RELATED U.S. APPLICATIONS

Not applicable.

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STATEMENT REGARDING FEDERALLY SPONSORED  
RESEARCH OR DEVELOPMENT

Not applicable.

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REFERENCE TO MICROFICHE APPENDIX

Not applicable.

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FIELD OF THE INVENTION

[0001] The invention relates to a neutral electrode for HF surgery according to the precharacterizing clause of Claim 1, and to a conductive gel according to Claim 12.

BACKGROUND OF THE INVENTION

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[0002] When employing neutral electrodes care should always be taken to keep the contact resistance between the skin and the electrode apposed thereto from becoming too high, so as to prevent excessive warming of the human tissue by a flowing HF treatment current. High contact resistances occur primarily in patients with extremely dry skin, in adipose patients because of the high fat content of the tissue, or in some cases of very hairy skin, when the dense hairs prevent

complete contact between electrode and skin. The hairs can easily be removed by shaving. To deal with the problems of dry skin or adipose tissue, however, is distinctly more difficult. In order to prevent severe warming or even burning of the human tissue, therefore, the customary neutral electrodes have large surface areas, which counteract high current densities. Often several electrodes are employed in order to enlarge the effective area and thus reduce the current density.

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[0003] The reduction of contact resistance, in particular when there are problematic skin and/or tissue conditions, can often be accomplished only by the use of multiple electrodes or by making an electrode larger. However, this increases the costs and furthermore makes it more difficult to manipulate the electrodes.

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BRIEF SUMMARY OF THE INVENTION

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[0004] It is the objective of the invention to develop a neutral electrode of the kind cited at the outset further in such a way that, in particular in the case of problematic skin and/or tissue conditions, a reduction of the contact resistance is made possible in a simple and economical manner, as well as to disclose an electrically conductive gel for application of the neutral electrode.

[0005] This objective is achieved by a neutral electrode according to Claim 1 and by a conductive gel according to Claim 12.

[0006] In particular, this objective is achieved by a neutral electrode for HF surgery that comprises at least one electrically conductive section that can be brought into contact with a section of a patient's body, and also

comprises means for promoting blood circulation, which enhance blood flow at least within the section of the body that makes contact with this electrode section.

5 [0007] The objective is further achieved by a conductive gel with which to apply a neutral electrode to a body section of a patient, such that the conductive gel comprises capsaicin or a similar substance that promotes blood circulation.

10 [0008] An essential point of the invention resides in the fact that the insulating action of the tissue surrounding the blood vessels is reduced by blood flow through the finest capillaries. This enhanced flow can be achieved by using an appropriately configured neutral electrode and/or a gel that  
15 can be put onto the neutral electrode just before it is used. The conductive gel that contains the circulation-promoting agent and can, for example, be applied from a tube is available for all kinds of electrodes.

20 [0009] The at least one electrically conductive section of the neutral electrode in a preferred embodiment is coated with a conductive gel. As a result, the contact between electrode and skin is ensured.

25 [0010] Preferably the circulation-promoting means comprise a substance that contains a circulation-promoting agent. Because the tissue surrounding the blood vessels in principle has insulating properties, these can be counteracted when there is a high degree of blood flow through the tissue. With  
30 the help of the circulation-promoting substance, therefore, the contact resistance is reduced. This is advantageous in particular in the case of patients with dry skin and/or with adipose tissue below the skin.

35 [0011] In another preferred embodiment the at least one electrically conductive section of the neutral electrode is

coated with the substance containing the circulation-promoting agent. As a result, the region of the body section that receives enhanced blood flow is precisely the region crucial for the contact resistance, namely the tissue that is  
5 covered by the electrically conductive section.

[0012] Preferably the conductive gel contains the substance that includes the circulation-promoting agent. In this embodiment the increase of blood circulation can be obtained  
10 in a particularly simple and economical manner. The neutral electrode to which the conductive gel containing the circulation-promoting substance has already been applied is used in the same way as conventional neutral electrodes. The improved current conductivity between tissue and electrode  
15 can thus be achieved without any great effort, with no need for any special or even additional measures to be taken by the operating-theatre personnel.

[0013] In one possible implementation of the neutral electrode, the substance comprising the circulation-promoting agent is contained in the carrier material that encloses the at least one electrically conductive section. Often the electrically conductive sections of the neutral electrode are attached to the corresponding body section by adhesion, in  
25 which case the section is surrounded, e.g., by self-adhesive material. The circulation-promoting agent contained in the carrier material then enters the tissue covered by the neutral electrode immediately after the neutral electrode has been applied to the relevant section of the patient's body.  
30 The size of the carrier material can be adapted to the amount of agent required; for example, it may have a larger area than is the case for conventional electrodes. Incorporation of the agent into the carrier material is particularly useful when neutral electrodes are not delivered with the conductive  
35 gel, but must instead be provided with the gel by the operating-theatre personnel immediately before use.

Furthermore, the substance containing the agent cannot be accidentally removed, as can easily happen to gel layers when they are contacted by chance. Hence it is ensured that agent is always present in its entirety.

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[0014] In another advantageous embodiment of the neutral electrode in accordance with the invention the circulation-promoting means comprise elements that supply a stimulating current, for instance electrically conductive sections. In 10 this case circulation through the part of the patient's body covered by the neutral electrode is enhanced by this electrical current. This is particularly advantageous for patients who exhibit allergic reactions to circulation-promoting chemicals. In the case of re-usable neutral 15 electrodes, furthermore, the employment of a stimulus current is a simple and economical means of enhancing blood flow and thus keeping the contact resistance between skin and electrode low, or even reducing it.

20 [0015] It is further provided as one of the preferred embodiments that the elements conducting the stimulus current are disposed so that the stimulus current flows between at least two sections within the neutral electrode. It is advantageous that the conventional neutral electrode can thus 25 be used to transmit the stimulus current. With this embodiment no additional components are required at the neutral electrode. As a result, the circulation is enhanced in the most simple and economical manner.

30 [0016] In another preferred embodiment, the solution in accordance with the invention provides that the elements supplying the stimulus current comprise separate electrical connecting devices by way of which a current source is connected. The advantage here is that the stimulus current 35 can be supplied independently of the high-frequency

generator, for instance by means of a supplementary current source.

[0017] Alternatively or in addition it is possible for the  
5 stimulus current to be supplied by way of two further  
electrodes that have been embedded in the carrier material  
and additional conductor leads that have likewise been  
embedded in the carrier material. In this case, again, the  
carrier material could, e.g., have a larger area than that  
10 found in conventional neutral electrodes. Then the supply of  
stimulus current is advantageously entirely independent of  
whether the electrodes are in use.

[0018] Another preferred embodiment provides that the  
15 circulation-promoting means comprise heatable elements. For  
this purpose the carrier material comprises, on a side that  
faces away from the skin, fixation means such as snap  
fasteners or Velcro strips to retain a heat-storing element,  
e.g. in the form a gel cushion. The blood flow can thus  
20 advantageously be promoted efficiently and in an extremely  
skin-friendly manner.

[0019] In another preferred embodiment the circulation-  
promoting means comprise elements that can be heated by a  
25 direct supply of energy, for instance resistance or heating  
wires that have been incorporated into the carrier material  
and are provided with appropriate connector devices. For this  
purpose the carrier material is preferably designed with a  
larger area than that of a standard electrode. Connection to  
30 the heating device is easily performed, so that promotion of  
blood flow can be simply and rapidly accomplished.

[0020] Other embodiments of the invention will be apparent  
from the subordinate claims.

[0021] In the following the invention is described with reference to exemplary embodiments, which are explained in greater detail with reference to the attached drawings, wherein

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BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Fig. 1 is a drawing of a first embodiment of the  
10 invention, showing the side that faces the skin;

[0023] Fig. 2 is a drawing of a second embodiment of the invention, showing the side that faces the skin;

15 [0024] Fig. 3 is a drawing of a third embodiment of the invention, showing the side that faces the skin;

[0025] Fig. 4 is a drawing of a fourth embodiment of the invention, showing the side that faces away from the skin;

20 [0026] Fig. 5 is a drawing of a fifth embodiment of the invention, showing the side that faces away from the skin.

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DETAILED DESCRIPTION OF THE INVENTION

[0027] In the following description, the same reference numerals are used for identical parts or parts with identical actions.

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[0028] These illustrations of exemplary embodiments show neutral electrodes 1 with an equipotential ring that forms a region with electrically conductive sections 2". It should, however, be pointed out that the present invention is applicable to every kind of electrode, in particular conventional electrodes without an equipotential ring.

- [0029] Figure 1 shows a first embodiment of the invention, with sections 2, 2' and 2" and corresponding connector devices 5. The surface shown here is the one facing the skin.
- 5 The sections 2, 2' and 2" are here placed on a carrier material 3, and a substance 4 containing a circulation-promoting agent has been applied to the electrically conductive sections 2, 2' and 2" of the neutral electrode 1.
- 10 [0030] Neutral electrodes are often manufactured in such a way that a conductive gel that is needed for the contact between electrode and human tissue and has already been applied to the electrically conductive sections. It is then advantageous for this gel additionally to incorporate the
- 15 substance 4 containing the circulation-promoting agent, so that the neutral electrode 1 can be put into position with no special effort, in particular without any additional step in the work of the operating personnel. The application of the gel containing the circulation-promoting substance 4 to the
- 20 electrically conductive sections 2, 2' and 2" guarantees that when the electrode 1 is in use, blood flow will be optimal precisely in those parts of a patient's body through which the current is flowing back to the neutral electrode 1. On one hand, the gel causes the electrode 1 to be uniformly
- 25 apposed to the tissue, while on the other hand it conducts the current and thus produces a suitable contact resistance during the operation. The circulation-promoting substance 4 reinforces the effect of the gel and helps to lower the contact resistance.
- 30 [0031] Alternatively it is possible to apply to the electrically conductive sections 2, 2' and 2" only the substance 4, which contains the circulation-promoting agent. This possibility is applicable, for example, when no
- 35 conductive gel is to be used during employment of the electrode 1.

[0032] Figure 2 shows a second embodiment of the neutral electrode 1, in which the substance 4 containing the circulation-promoting agent is applied to the carrier material 3 of the neutral electrode 1, i.e. the material comprising the electrically conductive sections 2, 2' and 2". Again, a side that faces towards the skin is shown here.

[0033] As soon as the carrier material 3 comes into contact  
10 with the skin, the agent diffuses into the tissue and exerts its warming and/or circulation-promoting effect. To optimize blood flow through the skin underlying the neutral electrode 1, one possibility is to provide both the electrically conductive sections 2, 2' and 2" and the carrier material 3  
15 with the relevant substance 4. Especially in the case of adipose patients, an adequate blood circulation can thus be obtained.

[0034] A third embodiment of the invention is shown in Fig.  
20 3. Again, a side facing towards the skin is represented. This embodiment allows a stimulus current to be introduced into the human tissue covered by the neutral electrode 1, for which purpose the sections 2, 2' are designed as elements to supply the stimulus current. This embodiment exhibits both  
25 the conventional connector devices 5 of the sections 2, 2' disposed on the carrier material 3 and also additional connector devices 6.

[0035] The stimulus current can thus be supplied by way of  
30 the electrically conductive sections 2, 2' and the connector devices 5 of the sections 2, 2', which are already present, or also by way of separate connector devices 6. The connector devices 6 enable current to be supplied from a current source independent of a HF generator. It is also possible to provide  
35 supplementary conductive sections (not shown) that serve exclusively to transmit the stimulus current. Then

additional, supplementary connector devices should be provided for the supplementary sections. The promotion of blood flow by means of a stimulus current is preferable, for example, when patients exhibit allergic reactions to 5 particular circulation-promoting chemicals.

- [0036] Figure 4 shows a fourth embodiment of the neutral electrode 1, as seen from the side that faces away from the skin. The carrier material 3 that holds the sections 2, 2', 10 2" here comprises fixing devices 7 for the fixation of heatable and heat-storing elements 8, for instance counterparts of snap or Velcro fasteners. The carrier material 3 is therefore enlarged in this embodiment.
- 15 [0037] The element 8, e.g. a gel cushion, can be attached to the electrode 1 while in a warm state prior to the operation, and then gradually release the stored heat. While this occurs, the neutral electrode 1 can be covered by the elements 8 either completely or only partially. Partial 20 covering is advisable when the view should not be obstructed, because visual monitoring of the contact between electrode and body section is necessary.

[0038] Figure 5 shows a fifth embodiment of the invention, 25 again representing the side that faces away from the skin. The neutral electrode here comprises an element 9 that can be heated by a direct supply of energy, with connector devices 6a. Warming of the skin tissue in this case is brought about by resistor wires or heating wires 9 that are incorporated 30 into the carrier material 3 and enclose the sections 2, 2' and 2".

[0039] Depending on the intended application, a combination 35 of various circulation-promoting means is to be recommended in order to minimize the contact resistance between tissue and electrode, in particular also in adipose patients.

[0040] At this juncture it should be pointed out that all of  
the parts described above are claimed as essential to the  
invention, individually or in any combination, in particular  
5 the details shown in the drawings. Modifications thereof are  
familiar to a person skilled in the art.

[0041] List of reference numerals

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|-----------|--|
| 1         | Neutral electrode                                  |
| 2, 2', 2" | Electrically conductive section                    |
| 3         | Carrier material                                   |
| 4         | Substance containing a circulation-promoting agent |
| 15 5      | Connector devices                                  |
| 6         | Connector devices                                  |
| 6a        | Connector devices                                  |
| 7         | Fixing device                                      |
| 8         | Warmable elements                                  |
| 20 9      | Heatable elements                                  |